Procurement and Infrastructure Costs

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1. Introduction

In the United States, infrastructure costs are substantial: for example, state and local governments spent $187 billion on highways in 2018. Yet there is a growing concern that the quality of infrastructure is declining (U.S. Census 2018, ASCE 2017). Recent work by Brooks and Liscow (2020) documents road building costs in the U.S., finding that spending per mile tripled from the 1960s to 1980s. Not only has spending increased, but there is substantial heterogeneity in the cost per mile across states. This increase in spending is not explained by increases in labor or materials costs, or by states building the easy miles first.[4]

One potentially important, but currently untestable, hypothesis, is that procurement practices explain differences in infrastructure costs across states. Public procurement accounts for 25% of all government expenditures in the U.S., and, given the taxpayers' stake in this spending, is expected to be carried out efficiently (OECD 2017). A vast Industrial Organization literature on procurement shows, theoretically and empirically, that the design and implementation of procurement auctions has implications for total cost. While the existing literature provides evidence on specific programs in specific states on which rich data exists, there is no comprehensive data set on highway procurement practices across states. As a result, the literature has major blind spots on areas that could be very important to infrastructure costs, but lack data or useful within-state variation for any empirical design.

We will help fill this gap by conducting a 50-state survey of state Department of Transportation (DOT) procurement. This project will collect data on both written laws *and* procurement practice, using a survey based on the World Bank's Doing Business Procurement Module (Bosio et al. 2020). The questions on the laws measure the rules regulating procurement in each state, while the questions on practice measure the actual application of the law. An outcome of interest will be the alignment of law and practice. To this end, we will survey three groups in each state, who have complementary knowledge about state procurement: 1) procurement officers at each DOT, 2) road builders and engineers, and 3) lawyers.

With this data, we will create a public good with which scholars will be able to begin to quantify a potentially important cost driver for infrastructure projects in the U.S. In particular, we will be able to see how specific procurement laws and practices correlate with higher costs. This preliminary evidence could then lead to deeper dives—perhaps even causal estimates based on cross-state changes over time—once we have a preliminary sense of prime suspects of cost drivers. Policymakers can then use this analysis to reform procurement laws and practices as necessary.

We are a good team to work on this project: one of us is an expert in industrial organization and public finance and the other is an expert in the costs of building highways and is not only an economist but

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[3] We would like to thank Ed Glaeser, Joe Gyourko and Jeff Liebman for sharing their expertise on both the procurement process and survey practices.
[4] Complementary work by Mehrotra et al. (2020) finds that the building cost per mile increased five-fold between 1984 and 2008, while cost of resurfacing doubled between 1990 and 2008. Similarly, they find that input prices do not explain much of the rising costs for a mile of construction, but prices are important for the cost of resurfacing.

also a lawyer at Yale Law School, which helps bring legal expertise, as well as the branding of the nation's top law school, to the table.

2. Background on Highway Procurement

Following Bosio et al. (2020), we find it helpful to describe the highway procurement process in the following four chronological steps: (1) pre-bidding, (2) bidding, (3) execution, and (4) payment. The questions in the survey will also follow the chronological order of the procurement process. Procurement practices at each of these four stages have the potential to affect final highway construction costs.

In the first stage, pre-bidding, the procuring entity (which is the state DOT here) assesses its procurement needs and budget. The DOT decides which projects to complete and the size of each project (e.g., a project for 30 miles of road vs. three separate projects for 10 miles), and the state's engineer estimates the cost of each project. If there are only a few eligible contractors for a large complicated project, and these firms have capacity constraints, both the timing of projects and the size of the job have the potential to reduce the pool of potential bidders, reducing competition and driving up final procurement costs (Jofre-Bonet and Pesendorfer 2003, Best et al. 2019).

In the second, bidding, stage, the DOT determines the procurement method, the information made public for the project, and how the bids will be collected. The procurement method has a direct effect on costs, as different auction designs correspond to different optimal bidding strategies (Milgrom and Weber 1982).[5] Moreover, advertising and outreach potential bidders can have substantial effects on the level of entry and the ability of incumbent bidders to collude, which clearly affect auction outcomes.[6] The outreach effort is not specific to the auction design, thus it is not the focus of much of the IO procurement auction literature. Therefore, an important contribution of our survey approach is to collect data on these procurement practices which may not be codified in state regulations but have the potential to substantially affect costs.

Also in the bidding stage, the bids are collected and evaluated, and the contract is awarded. Discretion in the bid screening process creates the potential for corruption; a procurement officer can artificially reduce entry by kicking out bids for trivial reasons, thus allowing a favored bidder to win at a higher price (Charankevich 2020). Alternatively, ineffective bureaucracy, rather than corruption, could drive costs. When the bidding process is overly complicated, bidders may be more likely to make small technical mistakes that disqualify otherwise qualified bids (Best et al. 2019).

The third stage, execution, concerns everything that happens in the period between the commencement of work and when the project is completed. This includes delays, contract renegotiations, and additional work. Incomplete contracts can create a costly renegotiation process, which bidders might take advantage of when submitting bids in the bidding stage (Bajari et al. 2014).[7] Lastly, the payment

[5] There is empirical evidence that providing more information to bidders on the specifics of the project and engineer's estimate can reduce costs (De Silva et al. 2008); that evaluating bids on quality, not only price, provides incentives for faster delivery (Lewis and Bajari 2011); and that allowing bidders to shift risk exposure to the seller leads to lower bids (Bolontyy and Vasserman 2019).

[6] See Levin and Smith (1994), Porter and Zona (1993), Clark et al. (2018) for more on entry, collusion, and costs.

[7] Delays reduce commuter welfare, and therefore the total cost to incomplete contracts not only includes the financial cost of any overruns, but the cost to the commuters of facing longer delays (Lewis and Bajari 2014).

stage refers to the inspection and payment process. This is another step in the procurement process where ineffective bureaucracy can increase costs by creating delays.

3. Methodology

We rely on the framework of the World Bank Doing Business "Contracting with the Government" survey, which collected data on the procurement laws and practices of 187 countries (Bosio et al. 2020). In the Doing Business project, each survey respondent is given a "case study," which is an example road resurfacing project. They are then asked questions about the rules and practices that would dictate the procurement process of the project. We will follow this format in our survey.

3.1 Case Study

Our main departure from the Doing Business survey, besides the fact that we are surveying states instead of countries, is our focus on road building opposed to resurfacing. We will ask survey participants about the process for building 10 miles of 4-lane limited-access highway. Each respondent will be given a set of detailed assumptions on the contract, the road, the procuring entity, and the bidder. The case study will give a value of the contract based on the average cost of highway-building, and specify that the contract does not include other work, such as bridge building or exit ramps.[8]

3.2 Survey

We take as our baseline the set of questions from Bosio et al. (2020), amended as appropriate to the United States context, and to our focus on road building as opposed to resurfacing. The survey will be split into four sections, in order to follow the chronological order of the actual procurement process, as detailed in Section 2: (1) pre-bidding, (2) bidding, (3) execution, and (4) payment. The respondents will be asked about the rules that regulate each stage of the public procurement process, the procedure that would be followed for awarding a contract and executing the project of building 10 miles of a 4-lane highway, the length of each of these procedures, and the frequency of collusion or bribery.

The survey questions, though organized chronologically, are designed to collect information on transparency, competition, limits to exclusion, and the integrity of the contract. As discussed in Section 2, these issues may arise in different points along the procurement process, and have direct bearing on the final cost of procurement. Questions on the public availability of documents such as the engineers' estimate, number of registered bidders, and details of past contracts all concern transparency. Questions on outreach, advertising, or other attempts to increase participation are intended to collect information on competition. Questions on the bidder registration and pre-screening process focus on the limits to exclusion in the procurement process. Lastly, questions on renegotiation, changes in the project details, the ability to add subcontractors, and payments all concern the integrity of the contract.

To illustrate how the questions concerning procurement law and procurement practice differ, take the following example about competition in the bidding stage. The question on law reads: "*According to the legal framework, after the advertisement of an open tendering procedure, can the Procuring Entity require bidders to participate in a prequalification process before submitting an economic offer?*" The question on practice reads: "*In practice, does the Procuring Entity avoid requiring bidders to participate in a prequalification process*."

3.3 Sample and Data Collection

[8]The case study will further specify that procuring entity is the state DOT, and the contract is tendered through an open, competitive, public call for tenders. It will also give details about the hypothetical firm that wins the contract.

Our survey will target three groups in each state. Procurement officers will answer questions on both the regulation and practice of procurement in the state. Lawyers will primarily answer questions on the laws, and the road builders and engineers will primarily answer questions on practice. The road builders and engineers will be especially relevant for questions on parts of the process where lawyers may be less involved, such as the execution of the project and the payment phase.

Unlike the World Bank, we do not have the infrastructure and contact list of the Doing Business project. However, we do have sources for each group of survey respondents. For the procurement officers, we will assemble a list of procurement officers at each state DOT, using the public DOT websites. For the lawyers, we will use the membership list of the American Bar Association's committee of public contract lawyers who work in procurement.[9] For the road builders and engineers we will leverage the membership list of the American Road and Transportation Builders Association (ARTBA).[10] The advantage of partnering with a trade association is that they have the infrastructure to contact and survey their members already in place. ARTBA has a research team of their own, which collects data on the transportation infrastructure market, forecasts industry trends, and undertakes research reports on commission. Similarly, Gyourko et al. (2019) partnered with a trade association to collect data from city managers for the 2018 Wharton Land Use Regulation Survey.

3.4 Budget and Pilot Survey

We intend to use all of the grant money to finance the survey, to the extent that is permitted by the NBER. Gyourko et al. (2019) spent an estimated $40,000 surveying city managers through the International City/County Management Association (ICMA). This included the email of the survey to the members of ICMA, the data collection through the electronic survey platform, and an extensive series of follow-up phone calls to confirm responses and ask clarification questions. We will follow a similar strategy, first sending the questionnaire over email, and then placing follow-up calls to increase participation and to clarify submitted responses. Since we plan to survey three groups—procurement officers, lawyers, and contractors—though for a smaller number of government entities than Gyourko et al. (2019), we estimate that our costs will be approximately $100,000.

We are currently finalizing the draft of the survey and piloting it with procurement officers in Colorado, Rhode Island, and Connecticut. Using the responses of the pilot, we will finalize the case study and questionnaire, and put it out in the field.

4. Outcomes

Our primary outcome of interest is the new data set we will produce on procurement laws and practices across the 50 states. We will use this data to correlate highway cost per mile and state procurement practices. We have data on highway cost per mile, as well as resurfacing and paving costs, by state, from Brooks and Liscow (2020), Mehrotra and Uribe (2020), and the Reason Foundation (2018).[11]

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[9] See https://www.americanbar.org/groups/public_contract_law/committees/state-procure/.

[10] The American Road and Transportation Builders Association (ARTBA) is a trade association that has 8,000 members from the public and private sectors (this includes contractors, planning and design, transportation officials, and more). Their policy objective is investment in transportation infrastructure. See https://www.artba.org/.

[11] An advantage of studying this topic across states, instead of countries, is that many states have publicly available data on procurement outcome (e.g., number of bidders, winning bids, cost overruns, and delays). Therefore, we can also correlate procurement outcomes with procurement practices. Our survey asks about the frequency of outcomes such as delays and overruns, which we will cross-validate this with publicly available data from a subset of states.

Given the correlations between specific procurement practices and realized costs, we will be able to identify important cost drivers, and collect historical data on those specific practice. The historical perspective will allow us to speak to the causal effect of procurement practices on costs by exploiting cross-state changes over time. As well, future rounds of the survey can help identify how changed procurement practices change costs.

We can think about our results in the framework of a generalized model of procurement. We will use the model to make predictions of what practices and regulations should lead to higher costs, and then test those predictions in the data. Information we collect on actual practices can also speak to where the theory may disconnect with the reality of the procurement process and inform policy.

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